DUPLICATE

HYDROLOGICAL MEMORANDUM No.46

UDC 551.501.9 : 551.579 : 556.04

METEOROLOGICAL OFFICE
26 MAR 1985
LIBRARY

145415

METEOROLOGICAL OFFICE NUMBERING SYSTEMS for HYDROMETEOROLOGICAL PURPOSES

by

KENNETH WOODLEY

March 1985

3 8078 0002 7006 8

ORGS UKMO H

Meteorological Office, Bracknell

National Meteorological Library
FitzRoy Road, Exeter, Devon. EX1 3PB

METEOROLOGICAL OFFICE NUMBERING SYSTEMS FOR HYDROMETEOROLOGICAL PURPOSES

1. HYDROMETRIC AREAS

1.1 In the mid-1930's, the relevant government department introduced the concept of 'Hydrometric Areas', basically river basins, and Great Britain (that is, excluding Northern Ireland) was divided into numbered areas comprising main river basins with associated coastal strips, which were the basin of the then 'River Authority' administrative scheme for rivers management.

1.2 The numbering sequence started at 1 and continued through to 97 for mainland areas; principal off-shore islands or groups of islands were given numbers starting at 101 (Isle of Wight), through to 108 (Shetland Islands).

1.3 These areal numbers were adopted by the Meteorological Office; but with the advent of computer-based systems, these numbers were converted initially to 3 digits, with leading zeros as appropriate; for example, Area 1 became Area 001.

1.4 Arising from the 1974 re-organisation of the River Authorities into regional Water Authorities in England and Wales, and from 1975 the re-organisation in Scotland where, in addition to the River Purification Boards, the Regional Council system replaced County Councils, there were some changes in the boundaries, although, insofar as rivers management was concerned, the boundary changes were still catchment orientated. Thus, the original 1930's boundaries were amended in some cases either as a result of the re-structuring or as the result of some internal re-organisation delineating Divisions of the regional Water Authorities.

1.5 The Meteorological Office wished to retain links with the old Hydrometric Areas, whilst acknowledging the re-structuring, and this led to some changes in the Office's new computer-based dataset of those areas, known as 'Hydroset'. A modified numbering system was introduced, under which the Area numbers were increased from three digits to four, and these were given the format HHHh. The first three digits, HHH, continue the parent Area number as defined in the 1930's, and the fourth digit, h, is a supplementary number, equal to 0 whenever the Area has remained exactly as defined in the 1930's, but becomes 1, 2 ..., when changes have been made to the boundaries. For example, the original Hydrometric Area 37 comprised the group of rivers Holland, Colne, Blackwater, Crouch, Mar, Inglebourne, Beam and Roding, and would have retained a HYDROSET areal number of 0370 had not part of that area been administratively transferred from Anglian Water Authority's potential control into Thames Water Authority control. Thus, that part of the area within A.W.A. (comprising the rivers Holland, Colne, Blackwater, Crouch and Mar) was given the new Area number 0371, whilst the part falling within T.W.A. (comprising the rivers Inglebourne, Beam and Roding) was given the new Area number 0372. Similarly, at a later

date, a reorganisation of Divisional boundaries within the Welsh River Authority, sub-divided HHHh = 0600 into areas 0601 and 0602. (It should perhaps be stressed that then an area is sub-divided the sub-divisions are identified with h=1, h=2, never with h=0 retained and h=1: thus, h=0 clearly means that the Area remains exactly as defined in the 1930's.)

Northern Ireland & Channel Islands

1.6 The Meteorological Office extended the 1930's Area numbering system to allocate numbers to the principal basins of rivers within and adjacent to Northern Ireland, and also included the Channel Islands, utilising the Area numbers in the 109 to 120 range for these purposes. These numbers were subsequently translated into the HHHh format, each with h=0. The river basin boundaries adopted for Northern Ireland and adjacent areas of the Republic of Ireland were those defined on an all-Ireland map produced in the mid-1800's, and recently reprinted by Ordnance Survey, Dublin, without amendment, in 1958.

A new All-Ireland integrated Area numbering system

1.7 In part arising from the adoption by the Meteorological Office of the arbitrary 'Hydrometric Area Numbers' for Northern Ireland, in the HHHh range 0109 to 1160, discussions commenced in 1978 between the then Department of the Environment for Northern Ireland, Belfast, the Meteorological Office, and their equivalent bodies in the Republic of Ireland, with a view to introducing an agreed system of identification of Hydrometric Area boundaries over Ireland as a whole. This led to an agreement that the Irish main river basins would be numbered from 1 to 40.

1.8 As, however, Area numbers 1, 2 ... 40 were already allocated for Meteorological Office purposes to Areas in Great Britain when converted to the HHHh format, and HHHh numbers commencing with the figure 1 already existed for the off-shore islands, it was decided that for HYDROSET purposes the first figure of the HHHh group for the Irish Areas would be 2. Thus, Irish Area number 1 becomes 2010 in the HHHh format, and Area 40 becomes 2400 (h=0 throughout the Irish range).

1.9 A Table setting out the current Hydrometric Area numbers and their respective rivers, related also to the Section 3 'Rainfall Station Numbers', appears as ANNEX 3B to this document.

ANNEX 1-A Map of Hydrometric Areas with water authority boundaries, North Britain
ANNEX 1-B ....., South Britain

Annex 1-A

HYDROMETRIC AREAS

The WATER AUTHORITY BOUNDARIES are those related to river divisions, which are somewhat different from water supply, etc. boundaries, and which are related to the re-organization of 1974 in England and Wales, and of 1975 in Scotland. Parts of Wales were revised in April 1979

The HYDROMETRIC AREA NUMBERS are now in the HHHh format, where HHH is the original number allocated in the 1930s and h is a subdivision resulting from water authority re-organizations. Thus, when h = 0 the boundary remains that originally defined in the 1930s.

Over IRELAND agreement has been reached with relevant authorities in the North and South for the adoption of a single system: the format adopted by the Meteorological Office to integrate this system with the HHHh system in use for the U.K. is 2HH0, where HH is the Irish Hydrometric Number, to which 200 is added, and the h component is always 0. Hydrometric Station Numbers are allocated only for those catchments or parts of catchments within Northern Ireland.

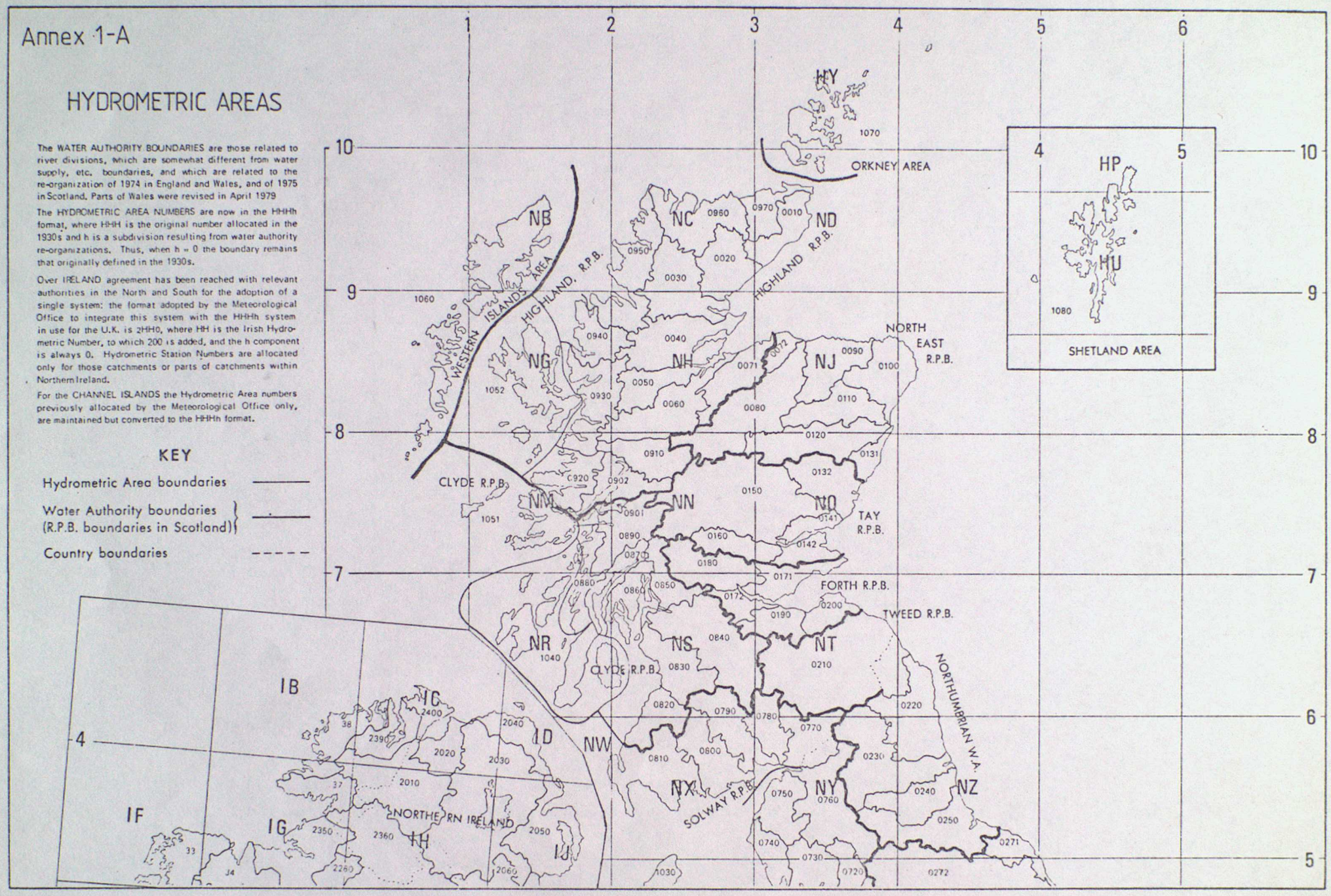
For the CHANNEL ISLANDS the Hydrometric Area numbers previously allocated by the Meteorological Office only, are maintained but converted to the HHHh format.

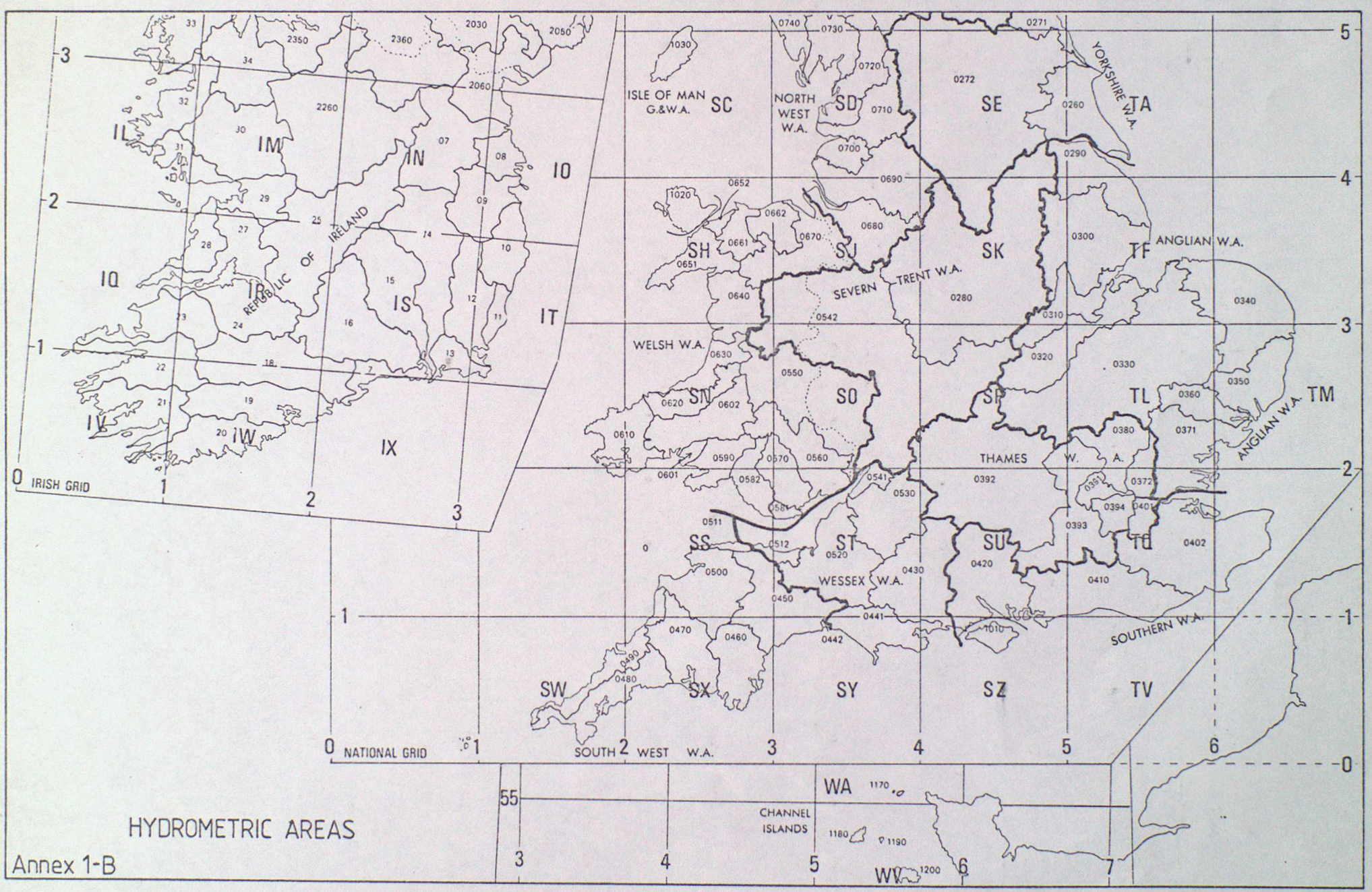
KEY

Hydrometric Area boundaries ——

Water Authority boundaries (R.P.B. boundaries in Scotland) — · —

Country boundaries - - - - -





HYDROMETRIC AREAS

Annex 1-B

2. COUNTY IDENTIFICATION NUMBERS

2.1 It is worth mentioning in this document the systems used by the Meteorological Office for identifying by numbers the counties of the United Kingdom, even though such boundaries are normally unrelated to catchments. Rainfall data has been processed since the days of the original 'British Rainfall Organisation' by catchments within counties, until the publication 'British Rainfall' ceased with the volume for the year 1968, although the drift away from county-related data commenced with the then new-style publication which commenced in 1960. Although the current successor publication 'Monthly & Annual Totals of Rainfall for the United Kingdom' completely excludes relationships between rainfall data and counties, the Meteorological Office is still asked to provide data on such a basis, and for this reason stations are still indexed with a computer-based link to counties.

2.2 The Meteorological Office has, however, maintained two County numbering systems, one for computer-based general climatological data, where the climatological station number, formatted DCnn, comprises the 'Monthly Weather Report' district (D), the county within the district (C), and the station within the county (nn), whilst the other has been used for hydrometeorological purposes. This document deals only with the latter system.

2.3 As was said above, rainfall data were stored and published in a sequence related to catchments within counties: perusal of the volumes of 'British Rainfall' prior to 1960 will readily show the system. It was for this reason that the Meteorological Office computer-based station numbering system (then called 'Hydrological Station Numbers') adopted the format CC-NNNNNN, where CC was a 'rainfall county number' and NNNNNN the individual station number. The counties in the U.K. were numbered from 1 to 99 (or in computer, CC, format, 01 to 99) and these were in use from 1961 to 1974.

Re-organistion of U.K. Local Government, 1974-75

2.4 The re-organisation of local government within Great Britain in 1974-75 led to county boundary changes, counties disappearing, merging, and the creation of the metropolitan counties, and so on. As there persisted a need to be able to identify rainfall stations, and of course their data, by county for some customer purposes, the old 2-figure CC number had to be changed: it was thought desirable to retain references to the 'old county' so that rather than simply re-allocating numbers to the new counties, a new system was evolved, involving initially a 3-figure number, known currently as the 'new county number'. The system devised is capable of further revision should Parliament make further local government changes in the future.

2.5 The 'new county number' can be regarded initially as being formatted as Ccc, where C is a U.K. 'country number':

0 = Scotland
1 = England
2 = Wales
3 = Northern Ireland
4 = Channel Islands

and cc is the county number within that country, commencing at 01 in the north (or north-east) of the country and progressing clockwise).

The Powys exception

2.6 For purely domestic reasons within the Meteorological Office and related to the allocation of old counties to districts for the purposes of the 'Monthly Weather Report' - see para. 2.2 above - the Welsh county of Powys has been divided into 'North Powys' and 'South Powys' since the area covered by the new county appears split between two M.W.R. Districts.

The Scottish Modification

2.7 For Scotland the 3-figure number should be regarded not as Ccc, but as CRc, where R is a number allocated to the Regional Council, and c is the (old) county, or part of a county, within that Region. This system was adopted in 1975 when the re-organisation of areas in Scotland was implemented because there appeared to be a strong retention of the original county names to identify the location of places, whilst the Regional Council were regarded simply as administrative bodies. The Meteorological Office new county system for Scotland (CRc format) permits of identification of places by either new Regional Council or old county name bases.

ANNEX 2-A Old county numbers (1961-1973)

ANNEX 2-B New county numbers (from 1974)

OLD COUNTY NUMBERS

(see para. 2.3)

CC	
01	London
02	Surrey
03	Kent
04	Sussex
05	Hampshire
06	Berkshire
07	Middlesex
08	Hertfordshire
09	Buckinghamshire
10	Oxfordshire
11	Northamptonshire
12	Huntingdonshire
13	Bedfordshire
14	Cambridgeshire
15	Essex
16	Suffolk
17	Norfolk
18	Wiltshire
19	Dorset
20	South Devonshire*
21	North Devonshire*
22	Cornwall
23	Somerset
24	Gloucestershire
25	Herefordshire
26	Shropshire
27	Staffordshire
28	Worcestershire
29	Warwickshire
30	Leicestershire
31	Rutland
32	Lincolnshire
33	Nottinghamshire
34	Derbyshire
35	Cheshire
36	South Lancashire
37	Central Lancashire
38	North Lancashire
39	West Riding (Yorkshire)
40	East Riding (Yorkshire)
41	North Riding (Yorkshire)
42	Durham
43	Northumberland
44	Cumberland
45	Westmorland
46	Monmouthshire
47	Glamorgan
48	Carmarthenshire
49	Pembrokeshire
50	Cardiganshire

CC	
51	Brecknockshire
52	Radnorshire
53	Montgomeryshire
54	Flintshire
55	Denbighshire
56	Merionethshire
57	Caernarvonshire
58	Anglesey
59	Isle of Man
60	Channel Islands
61	Wigtownshire
62	Kirkcudbrightshire
63	Dumfriessshire
64	Roxburghshire
65	Selkirkshire
66	Peebleshire
67	Berwickshire
68	East Lothian
69	Midlothian
70	West Lothian
71	Lanarkshire
72	Ayrshire
73	Renfrewshire
74	Dunbartonshire
75	Stirlingshire
76	Buteshire
77	Argyllshire
78	Clackmannanshire
79	Kinross-shire
80	Fifeshire
81	Perthshire
82	Angus
83	Kincardineshire
84	Aberdeenshire
85	Banffshire
86	Morayshire
87	Nairnshire
88	Inverness-shire
89	Ross & Cromarty
90	Sutherland
91	Caithness
92	Orkney Islands
93	Shetland Islands
94	Co.Fermanagh
95	Co.Armagh
96	Co.Down
97	Co.Antrim
98	Co.Londonderry
99	Co.Tyrone

*Devonshire was split into North and South because of the river drainage differences to the north and south coasts of the southwest peninsular, separated by Cornwall.

NEW COUNTY NUMBERS

ANNEX 2-B

(see para. 2.4)

C = COUNTRY prefix

0 = Scotland
1 = England
2 = Wales
3 = Northern Ireland
4 = Channel Islands

R = SCOTTISH REGIONAL COUNCIL

0 = (Islands)
1 = Highland
2 = Grampian
3 = Tayside
4 = Fife
5 = Lothian
6 = Borders
7 = Central
8 = Strathclyde
9 = Dumfries and Galloway

CRc	SCOTLAND
	ISLANDS
001	Shetland Islands
002	Orkney Islands
003	Western Isles
	HIGHLAND
011	Caithness
012	Sutherland
013	Ross & Cromarty
014	Inverness-shire
015	Nairnshire
016	Moray (in Highland)*
017	Argyll (in Highland)*
	GRAMPIAN
021	Banffshire
022	Aberdeenshire
023	Kincardineshire
026	Moray (in Grampian)*
	TAYSIDE
031	Angus
032	Kinross-shire
036	Perthshire (in Tayside)*
	FIFE
041	Fifeshire
	LOTHIAN
051	East Lothian
056	Midlothian (in Lothian)*
057	West Lothian (in Lothian)*

CRc	SCOTLAND (contd)
	BORDERS
061	Berwickshure
062	Peebleshire
063	Selkirkshire
064	Roxburghshire
066	Midlothian (in Borders)*
	CENTRAL
071	Clackmannanshire
076	Perthshire (in Central)*
077	Stirlong (in Central)*
078	West Lothian (in Central)*
	STRATHCLYDE
081	Dunbartonshire
082	Renfrewshire
083	Buteshire
084	Lanarkshire
085	Ayrshire
086	Stirling (in Strathclyde)*
087	Argyll (in Strathclyde)*
	DUMFRIES & GALLOWAY
091	Wigtownshire
092	Kirkcudbrightshire
093	Dumfriesshire

* See para. 2.7, and also note that where in Scotland c is 6 or greater then the reference is to only a part of the county; the remainder of that county will be found in other Region(s).

/Continued overleaf

Ccc ENGLAND

101 Northumberland
102 Tyne & Wear
103 Durham
104 Cleveland
105 North Yorkshire
106 Humberside
107 Lincolnshire

108 West Yorkshire
109 South Yorkshire
110 Nottinghamshire
111 Leicestershire
112 Northamptonshire
113 Derbyshire
114 Warwickshire
115 Staffordshire
116 West Midlands
117 Shropshire**
118 Hereford & Worcester
119 Gloucestershire
120 Buckinghamshire
121 Oxfordshire

122 Norfolk
123 Suffolk
124 Essex
125 Cambridgeshire
126 Bedfordshire
127 Hertfordshire

128 Wiltshire
129 Berkshire
130 Surrey
131 Greater London
132 Kent
133 East Sussex
134 West Sussex
135 Hampshire
136 Isle of Wight

137 Dorset
138 Somerset
139 Avon
140 Devon
141 Cornwall
142 Scilly

143 Cheshire
144 Greater Manchester
145 Merseyside
146 Lancashire
147 Cumbria
148 Isle of Man

** for a time Shropshire was officially called Salop.

Ccc WALES

201 Powys, South*
202 Gwent
203 Mid Glamorgan
204 South Glamorgan
205 West Glamorgan
206 Dyfed
207 Powys, North*
208 Gwynedd
209 Clwyd

*see para.2.6 of main text

Ccc NORTHERN IRELAND

301 Londonderry
302 Antrim
303 Down
304 Armagh
305 Tyrone
306 Fermanagh

Ccc CHANNEL ISLANDS

401 Alderney
402 Guernsey
403 Sark
404 Jersey

APPENDIX to ANNEX 2-B

COUNTY groupings linked to the "Monthly Weather Report" DISTRICTS

MWR District		Ccc/CRc groupings
0	...	001 to 017
1	...	021 to 066
2	...	101 to 107
3	...	122 to 127
4	...	108 to 121
5	...	128 to 136
6	...	071 to 093
7a	...	141 to 146
7b	...	207 to 209
8a	...	201 to 206
8b	...	137 to 140 & 401 to 404.
(9)	...	301 to 306

---

3. RAINFALL STATION NUMBERING SYSTEM

Early B.R.O. Numbering Systems

3.1 The early 'British Rainfall Organisation' introduced a numbering system for rainfall stations in the mid-1800s, and at the outset the system was straight-forward, starting at 1, 2 ... for stations within the pre-arranged river/tributary order within counties. As new stations commenced they were slotted into the numbering system, such that, for example, a station being added between 884 and 885 was simply numbered 884/1, and if another station was inserted between 884/1 and 885 it was numbered 884/2.

3.2 During the period that the B.R.O. was operating there were recognisably two re-numbering exercises some decades apart, during which they simply took all existing reporting rainfall stations and started from 1, 2 ... again. Thus, it is important to realise, when looking at any old records (such as the Met.O. 10-year summary sheets) the same station was likely to have slightly different numbers during its period of operation.

3.3 Expanding networks, etc. led to the increase in complexity of the numbering, for there developed resistence towards re-numbering exercises, the aim then becoming one of retaining a station number once allocated. Thus, by the end of the era of using this type of numbering system - that is, in the 1950s - station numbers existed in a three or four level format, such as 1234/4/1/3.

The new numbering system

3.4 During the latter part of the 1950 decade, when machinable data processing systems first came into use for rainfall station, using punched cards and the 'Hollerith' system of sorting and limited arithmetic, it became obvious that the early numbering system could not be continued, and consideration was given to a number of possibilities which were suitable for machine processing in the then newer forms of paper tape and magnetic tape.

3.5 It was during the 1950s that the Meteorological Office started using the Ordnance Survey 'national grid reference' system as the primary means of identifying the location of meteorological reporting stations in Great Britain, and the differently based 'Irish national grid' for sites in Northern Ireland. Sites were defined to the 100-metre accuracy for publication purposes, although domestic records often held the site location to 10-metre accuracy once O.S. maps and plans were available to permit of this. One of the schemes considered for rainfall station numbering in around 1957 was the straight-forward one of adopting the National Grid Reference as the station number: this would have involved a station number of some 9 digits if the 100-metre level of N.G.R. was to be adopted, that is, the station number would be EeeeNNnnn (where E and NN are the 'main square' numerical values, and eee and nnn are the distances in 100s metres easting and northing respectively within that 'main square'). If, as seemed likely, it would become, with time, necessary to adopt a 10-metre accuracy, then the station number would become 11 digits long, i.e. EeeeeNNnnnn. There were cogent arguments against such long reference

numbers, not least the feeling that observers could not readily remember them, and there would be transcription errors, etc. Also, a minor change in the raingauge site would lead to a 'change in the station number' even though, for practical purposes, the data would almost certainly be homogeneous.

3.6 The adoption of the N.G.R. as the station number would, in any case, break the century-old system of handling rainfall stations on a hydrometric or catchment basis: such a break was considered not to be justified, for rainfall data were still primarily used in a hydrological context.

3.7 A numerical version of the old numbering system was, of course, considered, under which rivers and tributaries would be given numbers, then the individual sites would be given numbers within the catchments. Such a system is, in fact, used by some water authorities and by the Surface Water Yearbook, but the system has a drawback in practice: the numbering of stations within a catchment on an initial basis of 1,2,3... led to an inability to insert a new site in its 'correct' sequence. Again, with each river/tributary given a reference number, the overall station number length would be unwieldy, and might even result in a number longer than that of the 10-metre N.G.R.

3.8 For many of the purposes for which rainfall data are used, areal rainfall is computed, and this led to consideration of the adoption of a station numbering system based upon catchment areas, such that one could identify all the rainfall stations in any catchment (whether of a very large river or of a small sub-sub-sub-tributary) by simply knowing the 'first possible' and 'last possible' number for the particular part of a river or tributary. All raingauge sites between a station number given to the 'source' of the river/tributary and a station number given to any point on the river/parent river/ tributary would, therefore, be within that relevant catchment. Such a scheme if based upon natural drainage areas would be wholly hydrological in concept and application, and would (hopefully) remain unaffected by any administrative changes introduced by either central or local government, or by any of the various types of water supply, river drainage, etc. authorities.

3.9 Such a scheme could also be adapted to incorporate within the numbering system the expanding network of river flow measurement stations. An R.F.M. station would have a number allocated to it, and all rainfall stations having numbers between it and the number applicable to the relevant catchment source must be within the drainage area upstream of that R.F.M. station. (In the event, whilst a start was made on allocating numbers to R.F.M. station sites, the Meteorological Office decided not to publish R.F.M.Station areal rainfall data once it became clear that the further post-1960 expansion of the annual publication, 'British Rainfall', had to stop.)

3.10 A study of the 'official area' of the United Kingdom (that is, of Great Britain comprising England, Wales and Scotland and relevant offshore islands, and Northern Ireland and the Channel Islands) revealed the total area was somewhat less than 100,000 square miles. It was reckoned that, because of the density of the rainfall station network, it would be necessary to calculate areas to 0.1 sq.mile. These two facts produced the basis of the areal station numbering system which was adopted, and kept the station number down to six digits, whilst covering the whole U.K.; that is, the numbers would fall within the range 000001 to 999999.

3.11 In 1958 work commenced on producing basic working maps, delineating catchment boundaries on the One Inch to the One Mile Ordnance Survey maps, and this was carried out in consultation with the (then) River Authorities,

River Purification Boards, etc. in Gt.Britain. It is not appropriate to go into the detail of these discussions; suffice it to say that in many areas there was ready agreement, whilst in others there was not ready agreement because errors existed in the interpretation of the detail of the O.S. map (even when large-scale maps were consulted) and because in some cases long-standing River Authority catchment maps were proved to be wrong in fine detail. It took nearly two years for a small Meteorological Office team to carry out all the discussions, mapping, planimetering, correcting and adjusting, and to devise sets of parochial 'Met.Office Rules' to cater for the large number of real-life cases of apparent anomalies. A number of basic decisions were reached, generally in agreement with the river authority; but there were areas of disagreement (particularly in the way the Fenlands of East Anglia were to be treated) and the Meteorological Office, withan eye on its overall national scheme, took a number of local decisions.

3.12 It has to be admitted that, in the 25 years since the scheme was first put into practice, one cannot swear that all those early 'Rules' have been rigidly adhered to: indeed some were proved to be wrong and changes have been made, not necessarily always implemented retrospectively, BUT there exists in the Meteorological Office, Bracknell, a permanent archive status card-index system, wherein all the errors found, corrections made, implemented or not, are recorded in detail.

3.13 Difficulties were encountered very early on in the development stages simply from using the paper Ordnance Survey maps and the manual planimetering of areas.

3.13.1 It soon became obvious that planimetered areas on a map fell short of 'true areas', such that, for example, even the most carefully checked and re-checked planimetering of all the maps of Great Britain did not produce a total area in agreement with the 'official area' of Great Britain - assuming that one could agree on the particular published official figures!

3.13.2 Planimetering of an area on one day was likely to produce a different value to that of another day, due primarily to paper expansion or contraction due to storage or working-room atmospheric conditions changing.

3.13.3 Planimetering of a section of an already planimetered area required re-planimetering of the remainder area, to ensure that the adopted values for the two parts did add up to the original total area. This planimetering again of the two parts of a sub-divided area is, by the way, a very important part of the practical methods adopted for calculating areas, and hence the station numbers.

3.14 To cater for the differences found in practice between manually planimetered areas and the 'offical areas' of the countries of the U.K., the planimetered areas were enhanced by between 1% and 3% in determining blocks of station numbers, and the adopted numbering system incoporated a 'rounding up' element at the end of each main river and coastal block, such that not every value between 000001 and 999999 is used. If one refers to ANNEX 3B one finds that the River Wear numbers start at a rounded up number of 021000, whereas the last possible number of the River Tyne is only 020201. The points around the coast of the U.K. where this rounding up takes place are shown by an asterisk in ANNEX 3B.

3.15 Whilst it is not really practicable to list <u>all</u> the 'Rules' adopted by the Meteorological Office, it may be of general interest to include below some of the main problems encountered and how they were dealt with:

3.15.1 Most lakes (Lochs/loughs) encountered are elongated and they are ignored: a theoretical line of the river is drawn down the centre of the lake and is deemed to be the river; any side streams/tributaries flowing into the lake are projected from the lake bank to this centre line false river. The same principle is applied to even the largest U.K. lake, the rectangular Lough Neagh in Northern Ireland. Sea-lochs in Scotland are simply treated as being the sea.

3.15.2 The source of a named river was determined in consultation with the relevant river authority and this was checked against information given in the edition of Bartholemew's Gazetteer of Great Britain available at the time. For Northern Ireland, some marginal notes on some editions of the 1800s catchment map materially assisted in identifying a river's source.

3.15.3 Some rivers change names between source and estuary, and this seems the more likely to occur where a lake of some size exists. The best authoritative source of information is used and if that indicates that the river upstream is the source of the river as named downstream, then the whole river is deemed to have the same name. (This can be confusing when looking at some data published related to river names.) Sometimes the river upstream of a lake can be regarded as a 'tributary' of the 'main river' which is then deemed to have its source at the upstream end of the lake, i.e. the main river has a 'tributary' at its source! (The convention of using the upstream end of the lake as the 'main river' source stems from the need to ensure that side-streams flow into the 'correct' river-name.) Changes of name over short distances are ignored; for example, Thames-Isis-Thames is regarded throughout as Thames. Some care needs to be taken when following a river down- or up-stream, moving from one O.S. map to another, for there are instances of name-changes without a link.

3.15.4 Upland tarns are drawn with their particular catchment and they are arbitrarily added to an adjacent catchment; however the station numbers within the tarn catchment are <u>not</u> normally <u>within</u> the range allocated for that adjacent catchment.

3.15.5 In cases of catchment boundary doubt, reference is made to the 1:25,000 scale maps, or to larger scale maps, or to a later edition of the maps (even if on a new metric scale). In some cases on older maps there are examples of rivers apparently running uphill, usually across cols: the discrepancies are resolved usually by assuming the topography is correct. The adopted catchment must be copied carefully on to the master 1-inch map, and the area planimetered to 0.1 sq.mile.

3.15.6 Problems exist within the framework of the basic Meteorological Office 'rule' that only 'natural drainage' routes are to be used in the station numbering system. Canals are usually ignored. In the Fenland areas a number of long-standing man-made 'Drains' are recognised as drainage routes, but not all those recognised by the water authority are similarly recognised by the Meteorological Office numbering scheme. The recent development of motorways often affect real drainage routes; but these are ignored by the Met.Office system, which adheres to the original natural drainage route.

3.15.7 In general, off-shore islands are not normally considered big enough to warrant sub-division into river catchments unless the original River Authority, or lately the Water Authority, asked for this to be done (e.g. there are identified rivers on the Isle of Wight). An island is regarded as being an island even when

a causeway does exist naturally or man-made, submerged at high tide or not. (NB: The Meteorological Office 'Rainmaster' index of stations now rigidly adopts the relevant ISLAND name as the first element of any rainfall station on an island.)

3.15.8 Tidal waters are reckoned as being the sea, but often the tidal limits are not marked on the O.S. maps either directly or indirectly. In this connection it needs to be noted that within the Meteorological Office numbering system, no rainfall stations exist attributed to the River Humber. Also, for historical reasons the River Thames downstream of Teddington is regarded as 'coastal' because the river is tidal. (Many users of Meteorological Office data remain puzzled by the way that the Office regards London as coastal!)*

3.16 It is relevant at this stage to draw attention to the fact that within the river identification system, the Meteorological Office recognises differently 'main rivers' and 'minor rivers' even though both categories drain directly into the sea. Those rivers treated as 'main rivers' are the ones so identified historically by river and hydrological authorities of yesteryear (e.g. 1930s decisions). Minor rivers are identified on the special Meteorological Office computer dataset of river names (dataset name HYDROSET), as draining into "Coastal", whereas main rivers are deemed to drain directly into the sea. This is one of the conventions adopted by the Meteorological Office at the time the computer dataset and its linkage with the Rainmaster computer station index were devised.

3.16.1 It is perhaps worth recording here the fact that whilst the dataset, HYDROSET, contains river names in alpha-character form, it also contains a numerical code number for each named river: however, the numerical code is <u>not permanent</u>, but changes when the dataset is re-structured periodically along with a restructuring of the RAINMASTER index. The numerical code exists solely for internal computer convenience and cross-referencing of down-stream sequences in binary half-words.

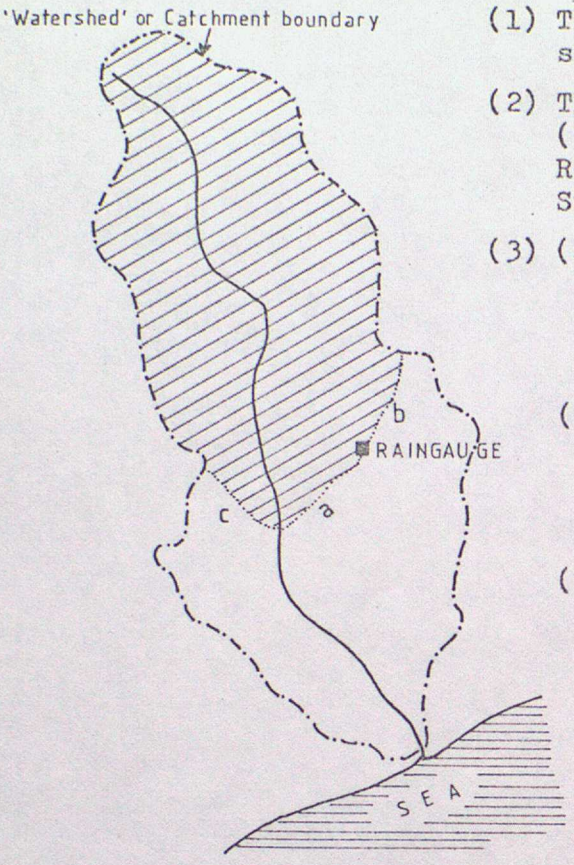
<u>Method of calculating the Rainfall Station Number</u>

3.17 It is complicated to describe in words the method of calculating the Meteorological Office Rainfall Station Number (which used to be called the Hydrological Station Number, but that term was withdrawn in 1980 due to confusion with other uses of the terms 'hydrological', 'hydrometric', etc.) The concept of determining the areas of the countryside within catchments is set out in Fig.1, and is expanded to show what happens when the raingauge site is within a catchment of a tributary (Fig.2), and further expanded in Fig.3. ANNEX 3A gives further examples from a working map point of view.

3.18 It is a vital part of the numbering system that the member of the Meteorological Office staff working on the Office's master maps used for this purpose, is fully conversant with all the fine detail of the points and pointers that exist on Ordnance Survey maps to identify (a) catchment and (b) natural down-hill drainage routes, rangeing from the straight-forward (such as the fact that the direct down-hill route always crosses altitude contours at right-angles to the contour at the point of crossing it), to the use of spot-heights to identify crests, cols, etc., to the finer detail of field boundary design and ditch drainage arrows, etc, etc. No attempt is made in this document to list all the criteria.

3.19 Figures 4(a) and 4(b) give in schematic form real examples to show how the station numbers are compiled in terms of relevant areas of the main river and its tributaries <u>and also</u> to bring to attention the way in

Fig.1 RAINGAUGE SITE IN CATCHMENT OF MAIN RIVER



(1) The catchment of the complete river, from sea via 'watershed' to sea must be drawn.

(2) The location of the raingauge must be plotted (to 100 metre accuracy by National Grid Reference on a 1-inch-to-the-mile Ordnance Survey map)

(3) (a) The correct downhill drainage route of rainwater falling at the raingauge site, following ALL relevant information on the map, down to the river is carefully drawn

(b) This route is 'extrapolated' backwards, uphill, to the catchment boundary, such that rainwater falling at that point on the boundary would drain naturally through the raingauge site to the river

(c) From the point of entry into the river determined at (a), the drainage route is again assessed, working uphill, on the opposite bank, such that rainfall at that boundary point would enter the river via natural drainage at the same point as determined at (a)

(4) The area upstream of that point on the river is determined by planimeter, to 0.1 sq.mile accuracy, say it is 16.3 sq.miles. The six-digit station number would, therefore, become 000163.

Fig.2 RAINGAUGE SITE IN CATCHMENT OF A TRIBUTARY OF THE MAIN RIVER

(1) The catchment of the complete river is drawn (as in Fig.1);

(2) The catchment of the main river upstream of the point of confluence with the triburary is drawn, and its area planimetered as A_1 which for example will be 145.7 sq.miles

(3) The raingauge site is plotted and action taken on the Triburary in line with Fig.1, steps 3(a)(b)(c), and the area upstream of the Tributary is measured as A_2 and for example it is 10.9 sq.miles.

(4) The area required to determine the Rainfall Station number is $A_1 + A_2$ and is, therefore, 156.6 sq.miles, which converted to a six-figure station number becomes 001566.

NB: It is not necessary to determine the catchment boundary of the complete Tributary, but it may be operationally convenient so to do.

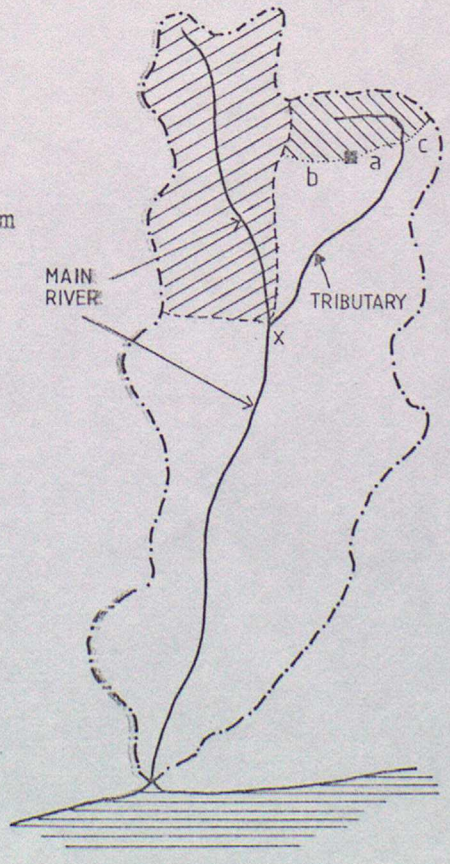
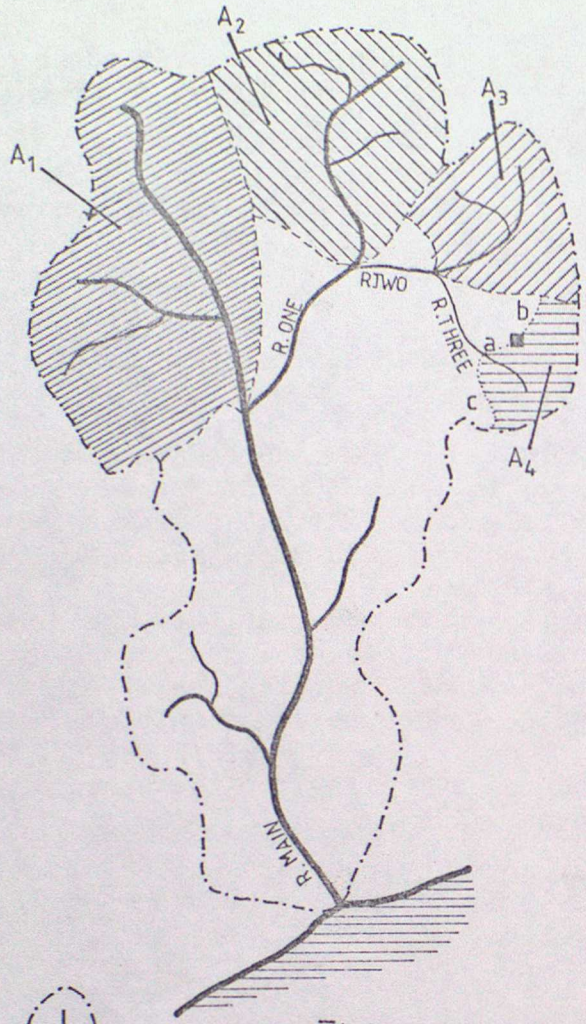


Fig.3 RAINGAUGE SITE ON THIRD-LEVEL TRIBUTARY



(1) The catchment boundary for the R.Main is drawn.

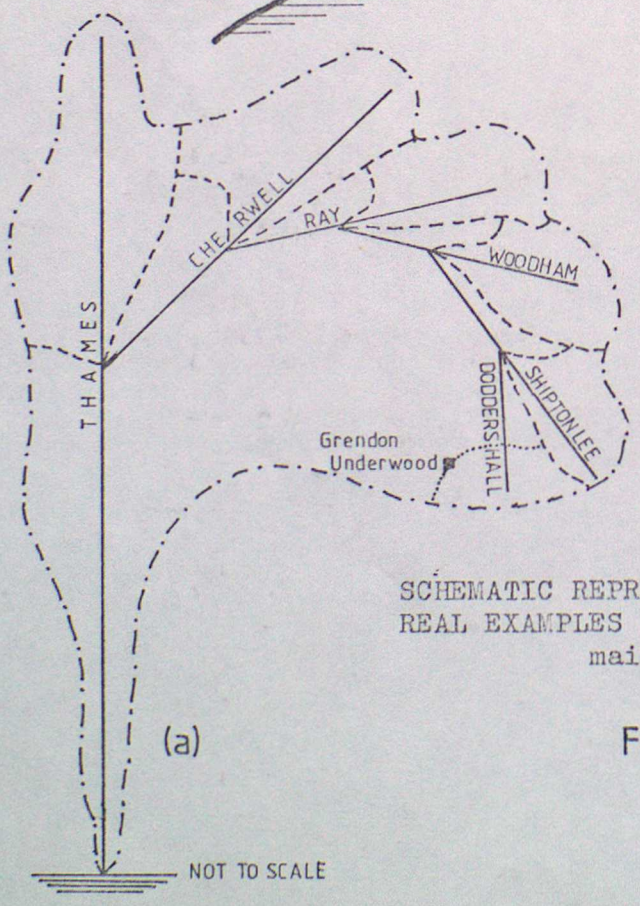
(2) The catchment upstream of the confluence between R.Main and its tributary, R.One, is drawn, and measured, A_1 = 184.3 sq.mi.

(3) The catchment upstream of the confluence between tribu ary, R.One and its own tributary, R.Two, is drawn, and its area measured, A_2 = 84.3 sq.mi.

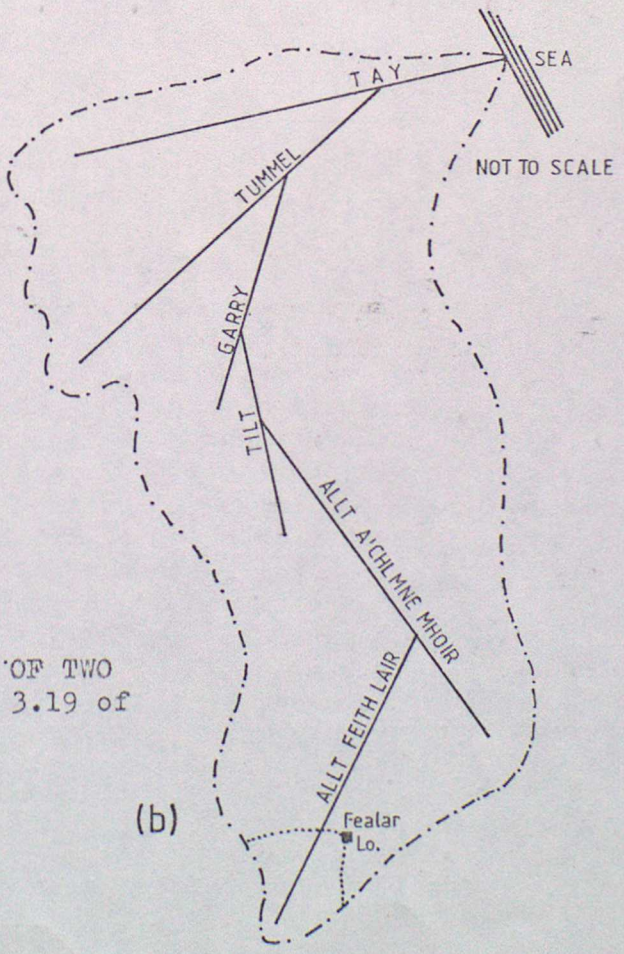
(4) The catchment upstream of the confluence between sub-tributary, R.Two, and its own tributary, R.Three, is drawn and measured, A_3 = 50.7 sq.mi.

(5) The raingauge is located within sub-sub-tributary, R.Three, and action is taken as Fig.1, Steps 3(a)(b)(c), to determine the area upstream of the point on R.Three into which rainfall at the raingauge site would naturally drain, A_4 = 13.8 sq.mi.

(6) The total area required to determine the station number is
$A_1 + A_2 + A_3 + A_4$ = 333.1 sq.mi and the station number therefore becomes 003331.



(a)



(b)

SCHEMATIC REPRESENTATION OF TWO REAL EXAMPLES (See para. 3.19 of main text)

Fig.4

which the resultant area has to be added to the 'previous area of the U.K.' so as to fit the numbers within the 'whole-U.K.' range, 000001 to 999999.

Fig.4(a) Station at Grendon Underwood, R.Stn.No. 258734

THAMES upstream of R.Cherwell	825.4
CHERWELL upstream of R.Ray	222.9
RAY upstream of R.Woodham	3.4
WOODHAM upstream of Shipton Lee	14.6
SHIPTON LEE upstream of R.Doddershall	6.7
DODDERSHALL upstream of raingauge site drainage point	.4
BROUGHT FORWARD (Area of UK prior to THAMES, rounded up)...	24800.0
TOTAL AREA	25873.4

Fig 4(b) Station at Fealar Lodge, R.Stn.No. 869781

TAY upstream of R.Tummel	456.4
TUMMEL upstream of R.Garry	321.6
GARRY upstream of R.Tilt	191.4
TILT upstream of Allt A'Chlmne Mhoir	22.3
ALLT A'CHLMNE MHOIR upstream of Allt Feith Lair	9.3
ALLT FEITH LAIR upstream of raingauge site drainage point..	1.7
BROUGHT FORWARD (Area of UK prior to TAY)	85975.4
TOTAL AREA.....	86978.1

3.20 From Figs.1 and 2 it will readily be appreciated that if another raingauge is located anywhere along the drainage lines a, b or c, that raingauge site will have exactly the same areal value as the original raingauge, and would therefore be given the same station number. However, the system is flexible, and when such an event occurs it is the custom to take the original raingauge number and either add 1 or subtract 1 from the original gauge's number: in some cases (where the areal value is large and no future problems can be foreseen one might adopt ± 2).

3.21 It is worth pointing out, also, that in some cases quite a small change in location can materially alter the station number. This can be demonstrated by reference to Fig.2. If a raingauge was located just upstream of the tributary confluence then the number would be the same as A_1, whereas if it were just downstream of the confluence then the number would comprise the complete area of the Tributary upstream of point X, added to the main river upstream area, A_1.

3.22 Similarly, a move of a raingauge across the brow of a hill can put the gauge into a different catchment - even a different main river basin - and in such cases the station number very materially changes. For example, a move of only a few yards in the central Penine area could change a number from the Cumbrian side from one in the 500000-group to one in the Northumbrian side in the 000000-group. The Meteorological Office allocates its rainfall station numbers strictly according to the drainage catchment, ignoring the 'authority' for the station. Thus, in the above example, North West Water could operate a station in the 000000-group, whilst all its others were in the 500000-group.

Inter-river coastal areas and off-shore islands

3.23 The areas between defined river estuaries which drain into the sea, either directly or via small streams which are outside the HYDROSET identification system, are treated in the same basic manner insofar as the calculation of the area is concerned. These areas are divided, as required, through the raingauge site by straight lines, notionally at

right-angles to the coastline, and the area planimetered in a clockwise direction, see Fig.5(a).

3.24 Off-shore islands are fitted into the areal arithmetic sequence again in a clockwise sequence around the coast. Unless exceptionally on larger islands individual rivers are identified, the straight lines through the raingauge site are normally drawn west-east, see Fig.5(b).

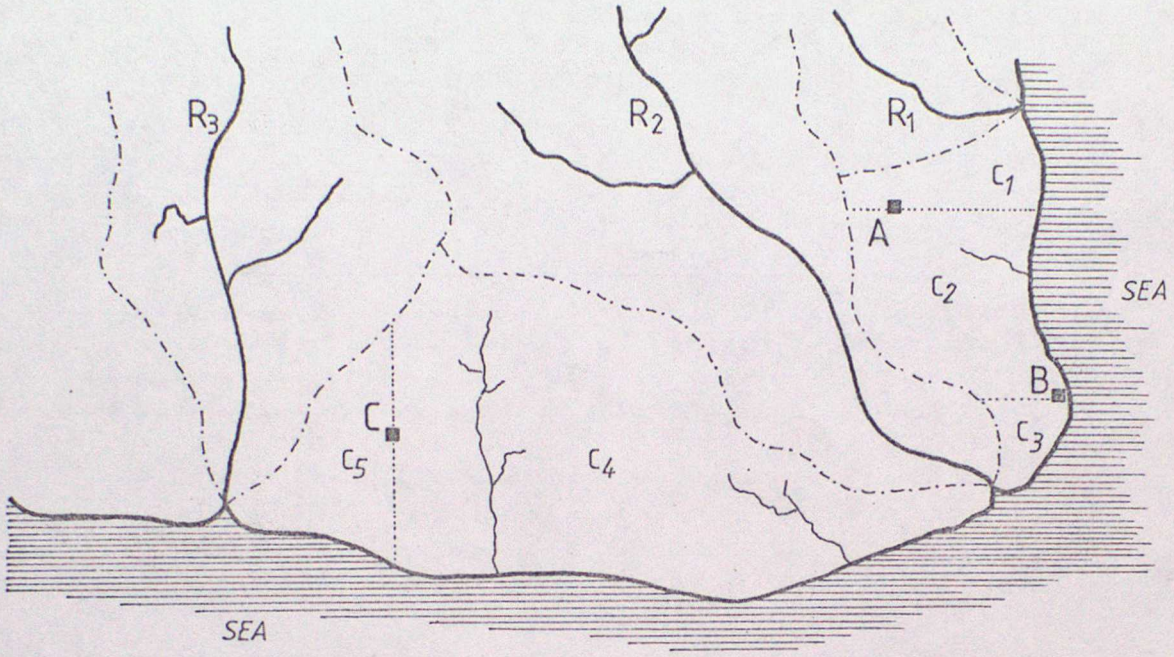


Fig. 5a

Station A = (*) + R_1 + C_1
Station B = A + C_2
Station C = B + C_3 + R_2 + C_4

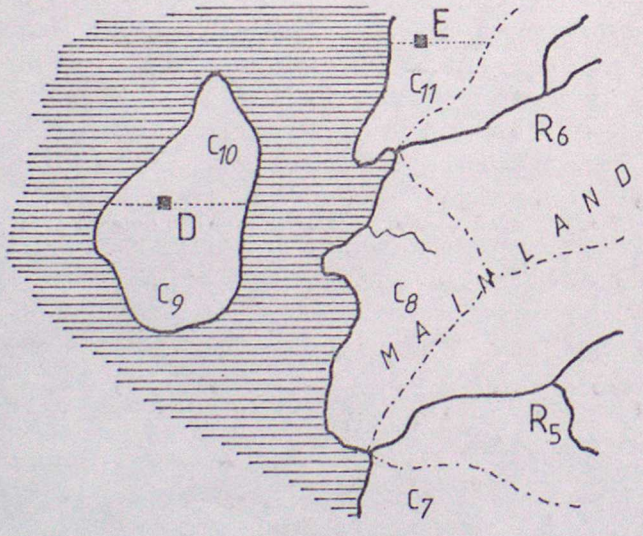


Fig.5b

Station D = (*) + C_7 + R_5 + C_8 + C_9
Station E = D + C_{10} + R_6 + C_{11}

where (*) is the relevant 'bring forward' UK area
R_1, R_2, R_3 ... are river basin areas
C_1, C_2, C_3 ... are coastal areas

Site changes leading to a change in station number

3.26 The Meteorological Office adopts a fairly strict system of changing a rainfall station number when there is a risk of a change in the homogeneity of the record. Certain arbitrary rules have been developed, and these are set out below: a rainfall station number will almost certainly

be changed whenever the raingauge site is

3.26.1 more than 400 metres/yards from the previous site;
3.26.2 more than 50 ft altitude difference from the previous site;
3.26.3 in a different stream catchment;
3.26.4 one whose environment (degree of shelter, over-shelter, over-exposure) is different, even if less than 400m or 50ft alt. different;
3.26.5 the type of rainfall collecting equipment changes so as to affect the homogeneity of the data sequence (eg. from a standard copper collector to a new-style tipping-bucket system of 0.2mm/tip, or from one tipping-bucket system to another, such as from 0.2mm/tip to 0.5mm/tip or 1.0mm/tip; this is because of potential changes in evaporation losses from the equipment).

3.27 The station number can be changed for administrative convenience, if there are advantages in doing this, such as, for example, a move within a village of less than 400m when the observer/authority changes. It has also become a convention that raingauges sites on airfields whilst operated by Meteorological Office or Royal Naval Air Station personnel will be given different numbers to raingauges maintained on the same sites by a different authority (eg. a Met.Office manned airport taken over by local staff).

3.28 As the station number is 'data-related', it has been the custom to permit the use of the same station number for rain-recorder data from the same site as the standard raingauge, provided that the rain-recorder data have been adjusted/corrected to agree with the standard raingauge. This should always be done for data extracted from tilting-siphon pattern rain-recorders: thus, TSR tabulations are normally held using the same station number as the parent standard raingauge. However, as tipping-bucket data are (currently) never adjusted to agree with the on-site standard raingauge, all tipping-bucket data raingauges/recorders are given different station numbers, following the practice set out in para. 3.20.

Errors found in past station number calculations are corrected

3.29 From time to time errors in the planimetering or definition of stream catchment boundaries do come to light. The practice of the Meteorological Office is to amend the station number and (at the earliest practical date) to transfer the data to the correct station number. There are, however, a few instances where this is not practicable: in such cases the master card index for the station will contain a clear note of the error. Index cards compiled incorrectly are never thrown away: they are retained as a permanent record, filed in the main numerical sequence and invariably cross-referenced to show the correct station number (which would have its own index card in its numerical sequence as well).

The allocation of rainfall station numbers within the Meteorological Office scheme is restricted to the relevant section of Met.Office Headquarters,Bracknell

3.30 It might be thought that since the numbering system is based upon defined catchment areas, anyone with an Ordnance Survey map could calculate a station number, even assuming the 'bring forward area of the UK' was known. In theory this is true, but in practice it is not so, as an early attempt to devolve this work within the Office to the regional offices in Belfast and Edinburgh revealed. Thus, all calculations have to be made using the parent set of master maps held at Bracknell.

3.31 The Meteorological Office does not, however, restrict the use of its numbering system to data it collects for national meteorological archive purposes. For a number of years, the Northumbrian Water Authority has itself collected data from raingauge sites unacceptable to the national archive, and the authority has used the Meteorological Office data numbering scheme rather than adopt one of its own, or use the system of the Surface Water Survey. The site details are provided to Bracknell in the usual way, and the number is allocated and put into the Office's station archival systems, but annotated to the effect that it is allocated solely for use by Northumbrian W.A. Such stations are included in the Meteorological Office 'RAINMASTER' index of rainfall sites.

Other related material

3.32 The Meteorological Office publishes a map, on scale 1:2 000 000, of the British Isles showing the Hydrometric Boundaries, within water authority boundaries, and with each area's first possible and last possible station numbers. The map is also overprinted with the national grid (for Gt.Britain), the Irish grid (for Ireland) and the Universal Transverse Mercator grid (for Channel Islands). The Hydrometric Areas as outlined in Annex 3B to this paper appear on the 1983 edition of that map.

3.33 For users of the RAINMASTER index, there exists an 'Abbreviated Guide to the Print-out' which is provided to customers having extracts from the dataset: for domestic use within the Meteorological Office there is also a write-up of the data-set structure, etc. Also for domestic use, there exists a write-up of the HYDROSET dataset structure, etc.

3.34 Rainfall observations from stations in the United Kingdom are published annually, some 2-3 years in arrears, in "Monthly and Annual Rainfall Totals over the United Kingdom for 1969" et seq. Prior to 1969, rainfall data using this numbering system were published in annual volumes of "British Rainfall" since 1960. Prior to 1960, rainfall data were not published with the previous style of station number in "British Rainfall".

Acknowledgements

3.35 I wish to thank Allen Lock and Derek Gardner of the Meteorological Office for the assistance in vetting the contents of this Memorandum and the Director-General for permission to include it within the Office's Hydrological Memoranda series after my retirement.

KENNETH WOODLEY

Lately Head of Hydrometeorological Data Systems

Meteorological Office, Bracknell
March 1985

EXAMPLES OF STATION NUMBER CALCULATIONS FROM A SPECIMEN WORKING MAP

3A.1 Figure 6 gives an idea of what a working map looks like for rainfall stations A, B ... M. In this example, however, it has been thought desirable, for the sake of simplicity, to omit extraneous Ordnance Survey map detail, such as topographical spot heights, contours, grid, etc: only the rivers and their tributaries have been shown and those required for the examples given names.

3A.2 All dotted lines represent manually pencilled-in working areas, and the italicised figures represent the planimetered areas (in square miles and tenths on an arbitrar scale), and these too would be written on to the maps in pencil.

3A.3 It is essential that it be appreciated that the areal values shown refer to the complete area between the dotted lines, irrespective of the existence of rivers or tributaries. Some of the catchments in this example map, as in real life, extend beyond the margin of the map, and, whilst in practice the equivalents of the dotted lines would be pencilled on to the adjacent maps with their respective areas, for this example, the areas of catchments assumed to be on the adjacent maps have been inserted in the margin (e.g. the area of the R.Main off this map is shown as +20.7 sq.miles): in the examples, these values are asterisked.

3A.4 For all the examples, it is assumed that there is a 'bring forward area of the UK' before the R.Main catchment of 1234.5 sq.miles.

3A.5 To assist understanding of the system, the actual calculations set out below commence with Station C, which is the site furthest upstream within the River Main catchment, and thus of the examples has the lowest Rainfall Station Number.

3A.6 For this first station, the basic system is explained: however, for subsequent stations, whilst the basic system is also set out, the alternative method is shown, for this indicates how one can avoid repeating the lengthy summing of areas by using the previous upstream station as a starting point. (Similarly, one can use, or use as a further check in cases of doubt, a downstream station number and 'work backwards' to achieve the new station number.) In these examples, all the component areas are explained, and the term 'unused catchments of ... ' has to be interpreted in accordance with para. 3A.3 above.

Station number calculations

STATION C (on R.Kernel)

Bring forward area of UK	1234.5	
Area of KERNEL upstream of station	0.4	(0.2 + 0.2*)
Area of STONE upstream of Kernel	1.1	(0.4 + 0.7*)
Area of PLUM upstream of Stone	7.6	(5.2 + 2.4*)
Area of MAIN upstream of Plum	24.3	(3.6 + 20.7*)
Area	1267.9	

Station Number (6-figure, with leading zeros as required) 012679

STATION D (on R.Pith) - 012846

B/F UK area	1234.5	
PITH upstream of station	0.2	
ORANGE upstream of Pith	9.0	(5.8 + 3.2*)
MAIN upstream of Orange	40.9□	
	1284.6	

□ comprising (20.7* + 3.6 + 0.1* + 7.4 + 0.7* + 0.4 + 0.2* + 0.2 + 2.4* + 5.2), where the (7.4 +0.1*) element is the unused catchments of the Main,Plum,Stone and Kernel when Station C was calculated.

Alternative method

Station C number (converted back to an area)	1267.9	
Unused Main,Plum,Stone,Kernel	7.5	(7.4 + 0.1*)
PITH upstream of station	0.2	
ORANGE upstream of Pith	9.0	(5.8 + 3.2*)
	1284.6	

STATION E (on R.Nutmeg) - 012964

B/F UK area	1234.5	
NUTMEG upstream of station	0.4	
NUT upstream of Nutmeg	3.8	(2.2 + 1.6*)
MAIN upstream of Nut	57.7□	
	1296.4	

□ comprising the (20.7* + 3.6 + o.1* + 7.4 + 0.7* + 0.4 + 0.2* + 0.2 + 2.4* + 5.2) to which is now also added (5.8 + 3.2* + 0.2 + 7.6)

Alternative method

Station D number (converted back to an area)	1284.6	
Unused Main	7.6	
NUTMEG upstream of station	0.4	
NUT upstream of Nutmeg	3.8	(2.2 + 1.6*)
	1296.4	

STATION B (on R.Nest) - 013015

B/F UK area	1234.5	
NEST upstream of station	0.2	
NUTHATCH upstream of Nest	0.4	
NUTMEG upstream of Nuthatch	4.9	(3.8 + 0.7* + 0.4)
NUT upstream of Nutmeg	3.8	(See Station E)
MAIN upstream of Nut	57.7	(See Station E)
	1301.5	

Alternative method

Station E number	1296.4	
Unused Nutmeg	4.5	(3.8 + 0.7*)
NEST upsteam of station	0.2	
NUTHATCH upstream of Nest	0.4	
	1301.5	

STATION F (on River Main) - 013364

B/F UK area	1234.5	
MAIN upstream of station	101.9□	
	1336.4	

□ comprising
MAIN upstream of Nut (Station E,B) 57.7 +
MAIN downstream of Nut to station (27.8 +
3.0*N + 2.3*NW + 1.8*W + 2.2 + 1.6* +
0.2 + 0.4 + 3.8 + 0.7* + 0.4)

Alternative method

Station B number	1301.5	
Unused MAIN between station and Nut	34.9	(27.8 + 3.0*N + 2.3*NW + 1.8*W)
	1336.4	

Note: 3.0*N is the northern boundary off-map area
2.3*NW is the northwest boundary off-map area
1.8*W is the west boundary off-map area

STATION G (on R.Pearl) - 013513

B/F UK area	1234.5	
PEARL upstream of station.....	0.4	
PEARMAT upstream of Pearl	1.0	
PEARMAIN upstream of Pearmat	2.7	(1.4 + 1.3*)
MAIN upstream of Pearmain	112.7□	
	1351.3	

□ comprising
MAIN upstream of Station F (See Stn F) 101.9 +
unused Main between Pearman and Stn F 10.8
(being 8.6 + 2.2*)

Alternative method

Station F number	1336.4	
Unused MAIN upstream of Pearmain	10.8	(8.6 + 2.2*)
PEARL upstream of station	0.4	
PEARMAT upstream of Pearl	1.0	
PEARMAIN upstream of Pearmat	2.7	(1.4 + 1.3*)
	1351.3	

/ STATION H

STATION K (on R.Peart) - 013642

B/F UK area	1234.5	
PEART upstream of station	1.2	
PEARTRIB upstream of Peart	2.0	
PEARMAIN upstream of Peartrib	13.8□	
MAIN upstream of Pearmain	112.7	(see Station G)
	1364.2	

□ comprising
(9.6 + 0.1* + 1.4 + 1.3* + 0.4 + 1.0)

Alternative method

Station G number	1351.3	
Unused PEARMAIN between Peartrib and Pearmat...	9.7	(9.6 + 0.1*)
PEART upstream of station	1.2	
PEARTRIB upstream of Peart	2.0	
	1364.2	

STATION M (on R.Pearhill) - 013676

B/F UK area	1234.5	
PEARHILL upstream of station	1.1	(0.8 + 0.3*)
PEARTRIB upstream of Pearhill	5.5	(2.3 + 1.2 + 2.0)
PEARMAIN upstream of Peartrib	13.8	(see Station K)
MAIN upstream of Pearmain	112.7	(See Stns G, K)
	1367.6	

Alternative method

Station K number	1364.2	
PEARHILL upstream of Station	1.1	(0.8 + 0.3*)
Unused PEARTRIB between Pearhill and Peart ...	2.3	
	1367.6	

STATION H (on R.Pearson) - 013994

B/F UK area	1234.5	
PEARSON upstream of station	0.4	
PEARMAIN upstream of Pearson	51.8□	
MAIN upstream of Pearmain	112.7	(See Station M)
	1399.4	

□ comprising
PEARMAIN upstream of Peartrib (see Stns K,M) 13.8 plus unused PEARMAIN between Pearson and Peartrib (including all of Peartrib), namely (29.6 + 1.8* + 0.8 + 0.3* + 2.3 + 1.2 + 2.0)

Alternative method

Station M number	1367.6	
Unused parts of PEARMAIN, PEARTRIB, PEART and PEARHILL	31.4	(29.6 + 1.8*)
PEARSON upstream of station	0.4	
	1399.4	

STATION L (on R.Pip) - 014098

B/F UK area		1234.5
PIP upstream of station		0.2
CORE upstream of Pip		0.4
APPLE upstream of Core		1.0
MAIN upstream of Apple		173.7 □
		1409.8

□ comprising

MAIN upstream of Pearmain	112.7	(See Station H)
PEARMAIN upstream of Pearson ...	51.8	(See Station H)
PEARSON upstream of Stn H	0.4	
Unused PEARMAIN, Pearson to Main	5.0	
Unused MAIN, Pearmain to Apple..	3.8	
	173.7	

Alternative method

Station H number	1399.4
PIP upstream of station	0.2
CORE upstream of Pip	0.4
APPLE upstream of Core	1.0
Unused PEARMAIN and PEARSON	5.0
Unused MAIN (Pearson to Apple)	3.8
	1409.8

STATION A (on River Main) - 014162

B/F UK area	1234.5
MAIN upstream of station	181.7 □
	1416.2

□ comprising

MAIN upsstream of Apple (see Stn L)	173.7
Unused parts MAIN, APPLE, CORE, PIP	6.4
Apple (1.0) + Core (0.4) + Pip (0.2)	1.6
	181.7

Alternative method

Station L number	1409.8
Unused parts MAIN, APPLE, CORE, PIP	6.4
	1416.2

3A.7 With the information from Station A, that the "Main upstream of Station A" has an area of 181.7 sq.miles, with the information given on the example map that the area downstream of Station A to the R.Main estuary is 1.0 sq.miles we know (and will have confirmed) that the total area of the R.Main catchment is 182.7 sq.miles.

3A.8 Knowing the 'bring forward UK area' as 1234.5, we can now state that all rainfall stations with numbers within the range 012346 (being 012345 + arbitrary 1 to give a number of top of catchment of R Main) to 014172 (being 1234.5 + 182.7) must lay within the River Main catchment.

3A.9 Similarly, from the information given in the various calculations we can also say that rainfall stations in the range

012346 to 012588 must lay in the MAIN upstream of the Plum river,
013473 to 014044 must lay within the PEARMAIN sub-catchment

and, if any of the 'unused parts' of catchments are further sub-divided by additional (dotted) catchment lines at river confluences, the station ranges for any of the rivers and tributaries can be determined.

River Flow Measurement sites

3A.10 Although R.F.M.Stations are no longer given numbers within this Meteorological Office scheme (see main text, para. 3.9), it is appropriate to instance a possible use of the information extracted and given in para. 3A.9 above insofar as rainfall data related to the R.F.M. station sites X, Y and Z (shown on the example map):

3A.10.1 RFM-X is located across the River Main just upstream of the confluence of the Pearmain. It has a notional number of 013472 (being 1234.5 + 112.7). Thus, data from raingauge sites between 012346 and 013472 must contribute to the river flow past that RFM site.

3A.10.2 RFM-Y is located across the River Pearmain, just before it joins the River Main. It has a notional number of 014044 (being 1234.5 + 112.7 + 57.2). Thus, data from raingauge sites between 013473 and 014044 must contribute to the river flow past that RFM site.

3A.10.3 RFM-Z is located on the River Main, just downstream of the confluence of the Pearmain, and would be given a notional number of 014045 (being 014044 + arbitrary 1). Thus, data from raingauge sites between 012346 and 014045 mustcontribute to the river flow past that RFM site.

Inserting a new station

3A.11 An example of inserting a new station is given in the following paragraphs, and the section of the Fig.6 map to be considered is extracted and shown as Fig.7. The new station is STATION N, in the R.Leaf which is a tributary of the R.Twig, in turn a tributary of the R.Pearmain.

3A.12 In this example the new station is higher up the valley of the R.Leaf than the Ordnance Survey map shows the actual river. For the purposes of rainfall station numbering, the river is extended up the dry bottom of the valley, to form a 'notional river', and the catchment upstream of the station is drawn in the usual way (see main text, Fig.1).

3A.13 The area of the R.Twig upstream of the R.Leaf will be required, and this area is defined, and is shown on Fig.7 as 'New area 2'. Similarly, the area of the R.Pearmain upstream of the R.Twig will be required and this, too, is delineated from the largest part of the original unused area, and is shown on Fig.7 as 'New area 3'. This leaves an unused area of the Pearmain/Twig/Leaf downstream on the Pearman of the R.Twig: this is shown on Fig.7 as 'New area 4.

3A.14 These new areas are planimetered, including the larger New area 3 (see main text para 3.13.3), to ensure that the total of New areas 1, 2, 3 and 4 equals the original area (which in this case from Fig.6 was 29.6 sq.miles).

3A.15 The number to be allocated to Station N can now be calculated, using information from Fig.7, plus original information from outside the area given in Fig.6.

STATION N (on R.Leaf)

B/F UK area	1234.5	
LEAF upstream of station	0.3	
TWIG upstream of Leaf	1.9	
PEARMAIN upstream of Twig	45.0 □	
MAIN upstream of Pearmain	112.7	(See Stn M, et al)
	1394.4	

□ comprising

PEARMAIN upstream of Peartrib ...	13.8	(see Station M)
New area 3	24.6	(22.8 + 1.8*)
PEARTRIB upstream of Pearhill....	5.5	(see Station M)
Station M area of Pearhill	1.1	(0.8 + 0.3*)
	45.0	

Alternative method

Station M number	1367.6	
New area 3	24.6	(22.8 + 1.8*)
LEAF upstream of station	0.3	
TWIG upstream of Leaf	1.9	
	1394.4	

Re-check

Station H number		1399.4	
Subtract			
Pearson upstream of station	0.4		
Pearmain, New area 4	4.6	5.0	-
		1394.4	

Thus, not only is the arithmetic checked, but it is confirmed that STATION N with its station number of 013944 correctly lies between Station M (013676) and Station H (013994) in the overall downstream sequence on the R.Pearmain.

"First possible" and "Last Possible" station numbers

3A.16 It is not practicable to produce a list of all the "first possible" and "last possible" station numbers for each of the hundreds of rivers and tributaries in the U.K. - not least because all the values have never been required to be worked out. However, for the linked data-entry checking system for RAINMASTER and HYDROSET datasets, the first need is to provide a schedule of these 'first possible' and 'last possible' station numbers related to the Hydrometric Areas (as defined in Section 1), and this schedule is set out in ANNEX 3B.

Master Archive-status Card Index of Station Number calculations

3A.17 ANNEX 3C shows the 'River Index' card, which is also used as a marker within the station number cards, and the Station Number index card completed as for STATION B (with ficticious County names and Grid Reference; but the station number does conform to the requirements of Hydrometric Area 0230 range: the entry 'Based on map' would, in practice, contain the O.S. map in the Met.Office map reference section used for station numbering).

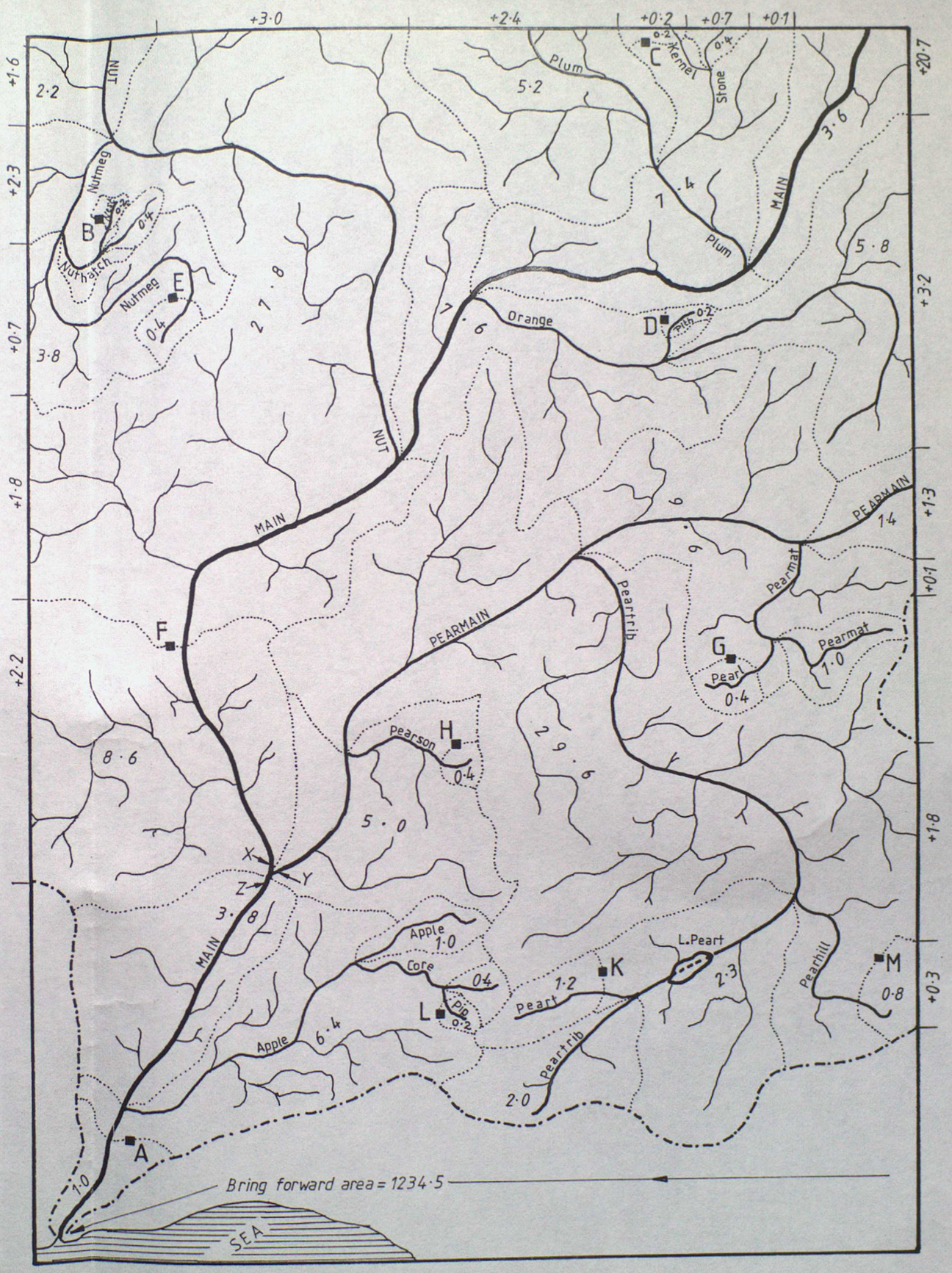


Fig. 6 [applies to Annex 3A]

EXAMPLE OF A WORKING MAP and particular attention should be paid to paras. 3A.2 and 3A.3

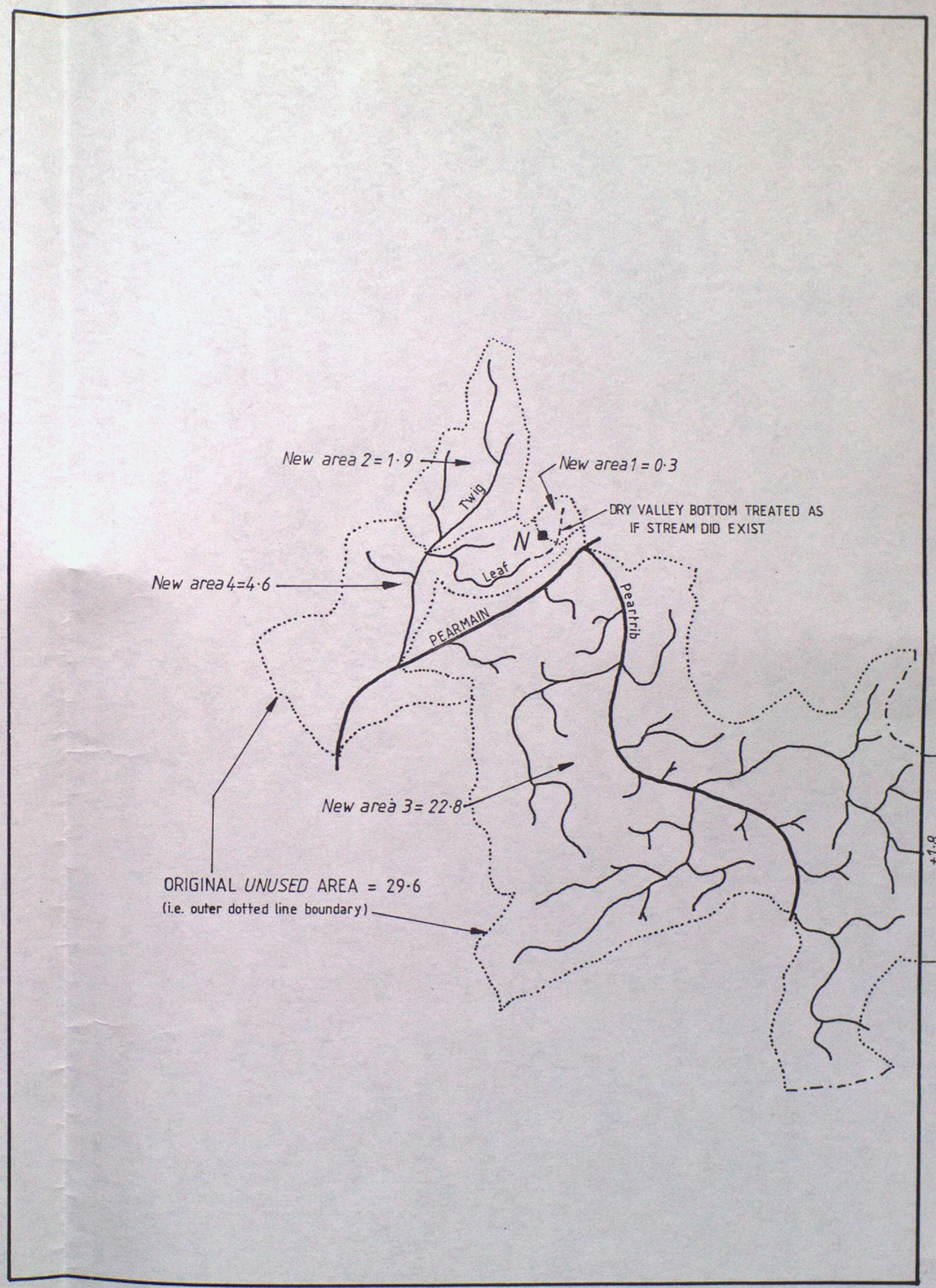


Fig.7 [applies to Annex 3A]

INSERTING A NEW STATION, *N*, INTO THE Fig.6 MAP

METEOROLOGICAL OFFICE HYDROMETRIC AREAS
(HHHh)
'FIRST POSSIBLE' & 'LAST POSSIBLE' STATION NUMBERS
grouped by water authorities

Hyd. Area HHHh	Rainfall Station Numbers First	Last	River names and/or ISLANDS, including inter-river 'coastal' areas within Hyd.Area boundary
			Northumbrian Water authority area
----	------	------	(Tweed, that part of Area 0210 in England)
0220	000001	008597	FARNE; Aln, Cocquet, Lyne, Wansbeck, Blyth
0230	008598	020201	Tyne
0240	021000*	025893	Wear
0250	025894	034661	Tees
			Yorkshire Water authority area
0271	035000*	037334	Esk
0260	038000*	046450	Gypsey Race, Holderness Drain, Hull, Foulness
0272	047000*	088619	Ouse
			Severn-Trent Water authority area
0280	089000*	129999	Trent
0542	420263	463999	Severn (above Sharpness)
			Anglian Water authority area
0290	130000*	137600	Ancholme, Skitter, Freshney, Waite, Lud, Eau, Willoughby High
0300	137601	150965	Steeping, Witham
0310	151000*	157369	Welland
0320	158000*	167419	Nene
0330	168000*	201999	Ouse, Babingley
0340	202000*	216617	Stiffkey, Glaven, Yare
0350	216618	222999	Hundred, Blyth, Minsmere, Alde, Deben, Gipping, Belstead
0360	223000*	227128	Stour
0371	227129	237521	Holland, Colne, MERSEA, Blackwater, Crouch, Mar
			++ Thames Water authority area
0372	237522	239670	Thames with Inglebourne, Beam, Roding
0380	240000*	245641	Thames with Lea/Lee
0391	246000*	247718	Thames (North bank downstream of Teddington to Lea), with Brent, Crane
0392	248000*	276164	Thames (Upper, from source to Egham)
0393	276165	286416	Thames (Lower, Egham to Teddington)
0394	287000*	289229	Thames (South bank, downstream from Teddington to Darent) with Beverley, Wandle, Effra, Ravernsbourne
0401	290000*	291706	Thames with Darent

* 'Rounded up', see main text para. 3.14

++ Special Areal system operating for Thames catchment, see main text, para. 3.15.8

HHHh	First	Last	River names and/or ISLANDS, etc.
			Southern Water authority area
0402	291707	308999	Medway, SHEPPEY, Oare Creek, Stour, Rother
0410	309000*	321629	Combe, Ash Bourne, Pevensey, Cuckmere, Moulsecoomb, Adur West, Adur, Adur East, Arun, Ryebank, Lavant, Ems
0420	322000*	332878	Wallington, Meon, Hamble, Itchen, Test, Lymington, Avon Water, Walkford Brook
1010	333000*	334516	ISLE OF WIGHT with Medina, Yar East
			Wessex Water authority area
0430	335000*	346845	Mude, Avon
0441	346846	351910	Bourne, Piddle, Frome, Brit
0512	397000*	398270	Avil, Washford, Doniford
0520	398271	409273	Parrett, Huntspill, Brue, Axe, Yeo, Kenn
0530	410000*	418829	Tetbury Avon, Avon
0541	419000*	420262	Severn (below Sharpness), Little Avon
			South West Water authority area
0442	351911	351999	Coastal area around Lyme Regis
0450	352000*	360887	Axe, Sid, Otter, Clyst, Exe
0460	360888	366943	Teign, Dart, Avon Water, Erme
0470	368000*	375252	Yealm, Plym, Tavy, Tamar, Lynher
0480	375253	381559	Seaton, Looe, Fowey, Fal, Devoran, Helford, The Looe
0490	381560	386473	SCILLY ISLES; (Mainland: Hayle, Gannel,Camel)
0500	387000*	395400	Torridge, Taw, Yeo, Caen
0511	395401	396387	Lyn, LUNDY ISLAND
			Welsh Water authority area
0550	464000*	480638	Wye
0560	481000*	487921	Monks Ditch, Usk, Ebbw
0570	488000*	491662	Rhymney, Taff, Ely
0581	491663	492382	Thaw
0582	492383	495771	Ogmore, Avan, Neath
0590	496000*	499570	Tawe, Lliw, Lougher
0601	499571	500257	Gwednraeth Fawr, Gwendraeth Fach
0602	500258	507517	Tywi, Taf, Cresswell
0610	507518	513529	Eastern Cleddau, SKOKHOLM ISLAND, Gwaun, Nefern
0620	513530	517467	Teifi
0630	517468	520905	Aeron, Arth, Ystwyth
0640	521000*	526345	Dovey, Dysunni, Mawddach
0651	526346	530834	Dwyryd, Glaslyn, Dwyfor, BARDSEY, Gwyrfai,Seiont
1020	530835	533662	ANGLESEY with Braint, Cefni; HOLY ISLAND.
0652	533663	534426	Coastal area around Bangor
0661	534427	537090	Conway
0662	538000*	541249	Clwyd
0670	541250	549725	Dee

* 'Rounded up', see main text para. 3.14

HHHh	First	Last	River names and/or ISLANDS, etc.
			North West Water authority area
0680	550000*	557499	Gowy, Weaver
0690	558000*	568686	Goyt, Mersey, Alt
0700	569000*	571432	Fine Janes, Douglas
0710	571433	577008	Ribble
0720	557009	583883	Wyre, Conder, Lune
0730	583884	588790	Beela, Kent, Winster, Leven
0740	588791	592415	WALNEY IS; Duddon, Esk, Ehen
0750	592416	597295	Derwent, Ellen, Waver, Wampool
0760	597296	606813	Eden
----	------	------	Esk (that part of Area 0770 in England)
			Isle of Man Gas & Water Authority
1030	607000*	609273	ISLE OF MAN with Silver Burn
			Solway River Purification Board area
0770	610000*	615319	Esk (except that part within England), Kirtle
0780	615320	619062	Annan
079C	619063	624816	Nith
0800	624817	630946	Urr, Dee
0810	630947	638866	Water of Fleet, Cree, Bladnoch, Luce, Piltanton
			Clyde River Purification Board area
0820	639000*	643212	Stinchar, Girvan, Doon
0830	643213	649143	Ayr, Irvine
0840	649500*	661518	Kip, Clyde (to confluence with Leven)
0850	661519	664920	Clyde (including Leven) to boundary of area 0850
0860	664921	668422	Eachaig, BUTE, Ruel
0870	668423	671204	Kinglas, Fyne, Shira, Dippin
1040	671500*	680443	ARRAN, mainland Kintyre, ISLAY, JURA, COLONSAY
0880	680500*	684066	Add, Euchar
0890	684067	689182	Awe, Kinglas, Etive
0901	689500*	690009	Creran
1051	715000*	719193	MULL, COLL, TIREE
			Highland River Purification Board area
0902	690010	692180	Coe, Leven, Nevis
0910	692181	699266	Lochy
0920	699500*	704036	Shiel
0930	704037	710571	Morar, Elchain, Ling, Carron
0940	710572	714726	Ewe
1052	719194	726550	EIGG, RHUM, SKYE
0950	738500*	747156	Dundonnell, Broom, Kirkaig, Inver, Laxford
0960	747500*	755166	Hope, Borgie, Naver, Strathy, Halladale
0970	755167	758723	Forss, Thurso
0010	769000*	772416	Wick, Berriedale
0020	772417	777795	Melmsdale, Brora, Fleet
0030	777796	785301	Evelix, Oykel

/contd

* 'Rounded up', see main text para. 3.14

HHHh	First	Last	River names and/or ISLANDS, etc.
			Highland RPB (contd)
0040	785302	793791	Alness, Glass, Peffery, Conon
0050	794000*	798195	Beauly
0060	798196	805951	Ness
0071	806000*	811529	Nairn, Muckle, Findhorn
			Western Islands area
1060	726551	738483	LEWIS, ST.KILDA, UIST, BARRA
			Shetland area
1080	759000*	764720	SHETLAND ISLANDS, FAIR ISLE
			Orkney area
1070	764721	768689	ORKNEY ISLANDS, SULE SKERRY
			North East River Purification Board area
0072	811530	813058	Lossie
0080	813059	824758	Spey
0090	824759	830791	Strathbeg, Deveron
0100	831000*	836506	Ugie, Cruden, Ythan
0110	836507	841750	Don
0120	841751	849999	Dee
0131	850000	851584	Cowie, Bervie
			Tay River Purification Board area
0132	851585	857897	North Esk, South Esk, Lunan
0141	858000*	859754	Dighty
0150	859755	879377	Tay
0160	879378	883142	Earn
0142	883143	885804	Eden
			Forth River Purification Board area
0171	886000*	889366	ISLE OF MAY, Leven
0180	889367	895701	Forth
0172	895702	897999	Carron, Avon
0190	898000	901543	Almond, Leith, Figgate, Brunstane, Esk
0200	901554	903999	Peffer, Tyne, Biel
			Tweed River Purification Board area
0210	904000	924452	Eye, Tweed (except that part in England)
			Northern Ireland
			NB: Those parts of catchments within the administrative area of Northern Ireland.
2390	925000*	925273	Skeoge
2400	925274	925289	Lough Foyle (west coast)
2010	925290	936871	Foyle
2020	937000*	940523	Faughan, Roe, and L.Floyle's south and east coasts

contd

* 'Rounded up', see main text para. 3.14

HHHh	First	Last	River names and/or ISLANDS, etc.
			N.Ireland (contd)
2030	940600*	963434	Bann including Lough Neagh
2040	963500*	967126	Bush, RATHLIN ISLAND, Glenshesk, Glendun and other northeastern streams
2050	967200*	974993	Woodburn, Lagan, Comber, Blackwater, Quoile
2060	975100*	980351	Kilkeel, Newry, Flurry, Castletown
2260	980500*	980514	Shannon (Upper),
2350	980515	981559	Drowes
2360	981663	998985	Erne
			Channel Islands
1170	999000*	999032	ALDERNEY
1180	999033	999291	GUERNSEY, LIHOU, HERM, JETHOU
1190	999292	999313	SARK
1200	999314	999762	JERSEY
			Special Annex for Meteorological Office administrative purposes
(1200)	(999800*	999999)	OVERSEAS STATIONS (e.g. Gibraltar, Falkland Islands, Seychelles, St.Helena)

* 'Rounded up', see main text para. 3.14

SPECIMEN ARCHIVAL INDEX CARDS

MAIN

RIVER NAME

or if COASTAL insert boundary limits: From ...../.....

To ...../.....

Area ..... Km² = 182·7 mi²

3% correction 5·5 mi²

∴ Corrected Accumulated River Area 188·2 mi²

SPECIAL NOTES

/

First possible Stn. No. 012346

Last possible Stn. No. 014172 (= Corrected Accumulated River Area MINUS percentage correction)

METEOROLOGICAL OFFICE RIVER INDEX
ARCHIVAL RECORD CARD NOT TO BE REMOVED

METEOROLOGICAL OFFICE RAINFALL STATION NUMBER
ARCHIVAL RECORD CARD NOT TO BE REMOVED

HYD STN No 013015

STATION NAME UNDER BR RULES Station B

HYD AREA No 0230

MARK X WHEN ENTERED ON 10 YEAR SUMMARY

	RIVER BASIN AND TRIBUTARIES	CALCULATED AREA
X	B/F area	1234·5
X	MAIN	57·7
X	NUT	3·8
	NUTMEG	4·9
	NUTHATCH	0·4
	NEST	0·2
	RESULTANT HYD STN No	1301·5

	COUNTY NAME	No
OLD	Testshire	43
NEW	Greater Newtest	101

EFFECTIVE DATE	GRID REFERENCE	ALTITUDE ft.	ALTITUDE m.
20.6.1935	NU (46) 568203	23	7
* 1.4.1962	NU(46)5682 2021	22	7
*			
*			

* FOR MINOR SITE CHANGES NOT INVOLVING A CHANGE IN HYD STN No

TERMINATION
Effective date

BASED ON MAP

Annex 3A	Fig. 6

PREVIOUS LINKED STN No	TRANSFER TO NEW STN No
/	

NB: Index Cards still in use refer to the obsolete term 'Hyd. Stn. No.'